ART. 2 NOTES ON THE EGGS AND EARLY LARVAE OF THREE MORE FLORIDA SALAMANDERS

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(Plate 18)

This paper is essentially a companion to one published recently (Goin: 1947 a) under a similar title.

Since the published descriptions of the larvae of many species and subspecies of salamanders are based on stages not at all comparable, and since both the form and color of the larval stages are known to be affected by the environment, I believe that the presentation of adequate descriptions and figures of the newly hatched larvae can serve two functions: first, to permit a comparison of two or more forms on the basis of determinable life history stage; and second, to record the features of the free living larva before local environmental factors have had an opportunity to modify them. So far as I know, the newly hatched larvae of the three following forms have not heretofore been described; therefore I take this opportunity to present descriptions and figures of them.

I am indebted to Messrs. Julian Baumel, John Decker, Edwin H. McConkey, John S. Mecham, and Gideon E. Nelson, all graduate students at the University of Florida, for spending many hours helping me hunt for the natural nests of our local salamanders. I am also indebted to Miss Esther Coogle, artist and research assistant of the University of Florida, for the drawings which accompany this paper.

Triturus viridescens louisianensis

A single egg of *Triturus viridescens louisianensis* was taken under a dead pine log in about two inches of water in a pond about five miles west of Gainesville, Alachua County, Florida, on January 8, 1951. This egg was at hatching stage when found and the larva

emerged shortly after it was picked up. Except for details of color pattern, this larva does not seem to differ essentially from the newly hatched young of *T. v. viridescens* from New York as described and illustrated by Bishop (1941: 65, fig. 14 b). The specimen is 7.5 mm. in total length. It has a well-developed balancer about half way between the eye and the base of the first gill. The front legs are present only as rounded blunt buds. A well-developed dorsal keel is continued anteriorly to a point above the base of the third gill. Bishop describes the New York specimens as having the pigment concentrated more or less into two rather broad bands which extend nearly the whole length of the body whereas in this specimen the dorsolateral bands are broken to give the appearance of blotches along the back. The tail keels are essentially unpigmented.

This specimen is identified as *louisianensis* on the basis of a number of adult individuals of this species which were found in the same general vicinity at the time and on the personal experience of both Dr. A. F. Carr and myself that *louisianensis* and *perstriatus* are not normally found associated in the same ponds.

Desmognathus fuscus auriculatus

The eggs and natural nests of *Desmognathus fuscus auriculatus* have been twice before recorded. Neill and Rose (1949: 234) describe a single clutch of eggs found on June 16, 1948, in Richmond County, Georgia, as follows: "The nest was a shallow depression beneath a scrap of bark at the edge of a sandy spring run. The female, a small specimen of 40 mm. snout-vent length, was coiled about the eggs. The eggs, six in number, averaged 7.7 mm. in diameter. Four of the eggs were held together by thread-like extensions of the outer envelope; the other two were separate."

Robertson and Tyson (1950: 132) record six nests taken near Grimesland, Pitt County, North Carolina, but do not give the exact dates on which the eggs were collected. They state that all of the nests found by them were within well-rotted cypress logs and stumps and that the individual clutches ranged in number from fourteen to twenty eggs. They further state that a female was associated with five of the six nests.

We have taken the eggs of *D. f. auriculatus* near a small spring run about three miles north of Gainesville, Alachua County, Florida. Ten

clutches of eggs in various stages of development were found on October 28, 1950, by the author and his students, and Mr. John S. Mecham collected one set on October 29. A few of the nests mentioned above had adult females apparently associated with them but in several cases so many *Desmognathus* were found in the vicinity of the nest that it was impossible to determine whether any one individual was associated with it.

Each of these nests was found on the side of a small natural hillock twelve to eighteen inches high and from one to three feet from the water's edge. In each case the eggs were deposited on the dirt under a layer of undisturbed sphagnum. They were generally attached to some small rootlet or similar organic structure.

Since some of the eggs were at hatching stage and the larvae emerged as they were disturbed, it was impossible to obtain exact counts in each case, but in five complete clutches in which the eggs were counted they numbered 9, 11, 14, 15, and 19 respectively. The eggs were approximately 5 x 7 mm. in size, ovoid in shape, with the more acute end tapering to a short, twisted stalk about 2 mm. in length. These stalks were in turn attached to a common base along the rootlet, so that the clutch had somewhat the appearance of a small cluster of grapes. Some of the living larvae within the egg capsules were coiled dextrally and some sinistrally. Most of them rested with the dorsal side uppermost, but a few were on the side and occasionally one would rest with the venter uppermost. Although most of the larvae were arranged in the capsule so that the head pointed towards the base of the capsule, a few were reversed so that the head pointed distally.

In one of the above clutches of eggs, five of the larvae were preserved as they hatched. These five range in size from 17.5 to 18.5 mm. with an average of 18.00 mm. This is somewhat larger than the measurements Bishop (1941: 318) reports for *D. f. fuscus* in New York.

In all of the larvae that hatched, the yolk seemed to be almost completely used up, since in none of the five specimens preserved at hatching is the belly appreciably distended, nor was a decided bulge noticeable in any of those that were not preserved.

The general tone of pigment in the hatchlings ranges from gray to brown and is concentrated on the dorsum and sides. The throat and most of the venter are immaculate with immaculate areas on the under

sides of the limbs. The distribution of the pigment is more diffuse than in *f. fuscus* as illustrated by Bishop (1941: fig. 61 a and b). There is a concentration of pigment in two narrow bands on each side of the mid-dorsal line, but most of the dorsum seems to have about the same concentration of pigment as does the side so that there is no impression of a broad dorsal dark band. Furthermore, the form and size of the dorsal light spots is different from that described for *f. fuscus*. In life these tiny spots were pearl gray in color and since they were small and not placed within a broad dorsal dark band they were barely noticeable. There are about six spots on each side of the back between the regions of the axilla and groin, and others on the basal half of the tail, but because they are not always arranged on opposite myotomes they do not give the impression of pairs of spots. On all of the newly hatched larvae there is a concentration of dark pigment between the eyes and a smaller concentration of pigment in the occipital region. The gills are as heavily pigmented as are the sides of the body. There is no pigment immediately around the nares.

Morphologically, these hatchlings seem to be very similar to those of *f. fuscus* except that the head is distinctly wider than the body, since the belly is not distended with yolk. The head is broad with the sides nearly parallel from back of the eyes to the base of the gills. The snout is short and converges rapidly to a truncated tip. The eyes are large and prominent. The toes are well developed. The legs are rather stout, with adpressed toes separated by about three costal folds. The tail is keeled above from a point above the vent to the tip, and below for the distal two thirds of the tail.

Manculus quadridigitatus

The presence of the striking dorsal fin in the larva of *Manculus quadridigitatus,* although known to some herpetologists, has never been reported. Therefore a special effort was made to collect the eggs and newly hatched larvae of this form.

Brimley's often cited record of the breeding site of this salamander "where the runlet from a certain small spring trickles sluggishly down a narrow cut," (Brimley, 1923: 81) implies that this species breeds along streams. In Florida the form is quite ubiquitous but all breeding sites so far located have been associated with ponds. Two clutches of eggs have been found recently.

The first of these was taken near the edge of a small hammock pond near Hale's Siding on the western end of Payne's Prairie, Alachua County, Florida, on November 22, 1950, by John S. Mecham. The eggs were under a wet log several feet from the water but only about two inches above water level. It was impossible to tell how much the clutch was disturbed when the log was rolled over, but there were about twelve eggs together in a small depression and about eight more scattered within a radius of six or eight inches. Dirt sticking to the adhesive eggs made them extremely difficult to see so that it is not certain that all of them were collected. There were about six adult *Manculus* in the same general area but none that could be definitely associated with the nest. These eggs started hatching December 7.

On January 14, 1951, Mr. E. H. McConkey found another clutch under a wet log about three feet from water. These eggs were grouped together in a depression about two and a half inches deep and were covered by a piece of loose bark. They were also adhesive and the loose dirt which stuck to them made them very hard to see. When they were put in a hatching pot similar to those used for *Eleutherodactylus* (Goin, 1947 b: 3) they were separated and found to be sixty-two in number. Judging from the dates on which they hatched it seems probable that there were two separate clutches involved. The first group hatched over a period of fifteen days from January 19 to February 2, inclusive. A total of forty hatched within this period, usually just one or two a day, but eight hatched on January 25 and ten on January 26. The second group started hatching on February 9 when one young emerged. Two more eggs hatched on February 12 and two more on the following day, February 13.

Both of the above deposition sites are more in accordance with the observations of Carr (1940: 48) than they are with those of Brimley. It is true that Carr says that the three clutches he found on January 15, 1935, were under logs lying in shallow water in a small pond, but it is easily conceivable that a hard winter rain might have inundated the nests after deposition.

In general appearance the newly hatched larvae of *Manculus* have a striking resemblance to those of *Hemidactylium scutatum* as illustrated by Bishop (1941: fig. 35 a). The specimen described below and illustrated in fig. 3 is one which hatched December 7 from the clutch collected on November 22. In general tone of pigment the hatchling

is a uniform grayish brown with the pigment distributed rather uniformly over the top of head and dorsum, the gills, the upper surface of the limbs and the sides of the tail. The chin, throat and venter are immaculate. Pigment is present in both the dorsal and tail fins but is more diffuse than it is on the rest of the body. The mouth is small and inconspicuous, ventral in position, and not visible from the side. The gills have relatively few filaments. The toes of the front foot are fairly well differentiated but the hind foot has no indication of toes. The most striking feature of the newly hatched larva is the dorsal fin which arises on the mid-dorsal line at about the level of the seventh costal groove and, being continuous with the tail fin, extends uninterrupted to the tip of the tail. Ventrally the tail fin continues anteriorly to the region of the vent. Five specimens from this clutch preserved at hatching range from 7.5 to 8.3 mm. in total length. Four specimens from the same clutch preserved eight to ten days after hatching range from 9.3 to 9.5 with an average of 9.45 mm. in total length. These specimens eight to ten days old differ from the hatchlings only in size and the fact that the toes of the hind foot have differentiated.

The individuals of the second clutch were preserved as they hatched. After about four days it was observed that the specimens that hatched later seemed to be a little larger in size than those that had hatched earlier from the same clutch. Thereafter those that hatched each day were preserved separately to permit determination of the variation in size as correlated with the time of hatching of a single clutch. Those that hatched between January 19 and 24 range from 8.3 to 9.0 mm. in total length and average 8.64. Those that hatched on January 25 range from 8.5 to 9.3 mm. in total length and average 8.9. Those on January 26 range from 9.0 to 10.0 with an average of 9.5, and all of the individuals that hatched January 28 and thereafter until February 2 were 9.5 mm. in total length. Furthermore, these larger individuals which were later in hatching had the hind toes better differentiated than did those that hatched earlier. Four of the five specimens that hatched between February 9 and February 13 inclusive were measured. Three of them were 9.0 mm. in total length while one was 9.5 mm.

Although the later specimens to hatch from the clutch were in general larger in size and had the toes better differentiated, they

seemed to be less hardy, at least under the ecological conditions prevailing in the hatching pot. I regularly preserved the specimens that hatched over a twenty-four hour period every night. All of those that hatched between January 19 and 26, inclusive, were still alive and quite active at the time of preservation whereas seven of the thirteen that hatched between January 27 and February 2 died before they could be preserved.

The dorsal fin apparently diminishes in size with larval growth since a specimen 21 mm. in head and body length (tail broken) collected near Cedar Keys, Levy County, Florida, September 7, 1950, and presented to me by Wilfred T. Neill, still has gills although the dorsal fin is much reduced so that only a remnant of it remains.

Heretofore, *Hemidactylium* has been reported to be the only plethodontid in which the larva has a dorsal fin and in which the hind toes may be undifferentiated at hatching. That the same condition prevails in another four-toed salamander of the same family does not necessarily, of course, imply a close relationship between the two, since the similarity of the larval condition may result solely from convergence. I do feel, however, that since the larvae of *Manculus* differ so strikingly from those of *Eurycea,* there is no justification for lumping these two genera on the basis of our present knowledge.

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EXPLANATION OF PLATE

Miss Esther Coogle, del.

FIG. 1. Lateral view of newly hatched larva of *Triturus viridescens louisianensis*. Actual size 7.5 mm.

FIG. 2. Dorsal view of same.

FIG. 3. Lateral view of newly hatched larva of *Manculus quadridigitatus*. Actual size 8.3 mm.

FIG. 4. Dorsal view of newly hatched larva of *Desmognathus fuscus auriculatus*. Actual size 18.0 mm.

FIG. 5. Lateral view of same.